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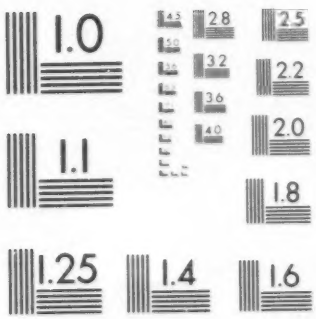

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ABSTRACT

In recent years researchers have examined the apparent discrepancy between the sexes in mathematical ability. To explore the relationship between mathematics achievement and sex, sex role identity, self-esteem, and locus of control, 260 college students (170 males, 90 females), from three mathematics course levels, completed Rosenberg's Self-Esteem Scale, the Rotter Internal-External Locus of Control Scale, the Bem Sex Role Inventory, and three mathematics achievement tests. Alternate forms of the achievement tests were readministered at the end of the semester. The sample was divided into three attendance groups, i.e., students who withdrew from the course, those who withdrew from the experiment but completed the course, and those who completed the course and the experiment (145 students). An analysis of the results showed no sex differences in math background or in attrition rates from the course or the experiment. No significant differences in sex role identity, self-esteem, or locus of control were found. However, female self-esteem did increase with course level, while male self-esteem was unrelated to course level. The male attendance groups did not differ significantly on math achievement scores, while the female groups did. Females who withdrew from the course evidenced significantly lower achievement scores than either of the other two attendance groups. (BL)

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Achievement in Mathematics as a Function of Sex, Sex Role Identity, Self Esteem, and Locus of Control

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Running Head: Math Achievement

Presented at 1984 APA convention Toronto

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Achievement in Mathematics as a Function of Sex, Sex Role Identity, Self Esteem, and Locus of Control

In recent years much research has examined the apparent discrepancy between the sexes in mathematical ability. Since differences in attitudes toward math and a decline in achievement appear to coincide for females, numerous researchers (Fennema, 1974a, 1974b; Hinders, 1977; Mednick & Weissman, 1975; Norman, 1977; Sherman, 1978; Stein & Bailey, 1973) contend that the source of these differences may be in sex role development. Research has identified a few personality traits that seem to be relevant to attitudes toward math and, subsequently, math performance. For instance, Staff (1976) found that internal locus of control and high self esteem correlated significantly with mathematics ability for high school girls, but not for boys. There are few studies examining the relationship between these personality variables and math achievement or learning among college students.

This study explores the relationships between math achievement and the personality variables that have been proposed to influence attitudes toward math and math ability for college students. In addition, the suggestion that sex differences in math achievement are largely due to math background (Sherman, 1982) will be further examined. Also, attrition rates by the sexes will be explored.

Method

Subjects

Subjects were college students enrolled in comparably sized sections of three mathematics course levels: Beginning Algebra, representing Course Level I (n = 58, 29 males, 29 females); College Algebra, representing Course Level II (n = 75, 50 males, 25 females); and Analytical Geometry and Calculus I, representing Course Level III (n = 127, 91 males, 36 females). A total of 260 subjects participated in the pretest stage. Due to withdrawals from the courses or the study and absences on the days of testing, only 145 students participated in the post-testing.

Measures

Rosenberg's Self Esteem Scale (RSE) was employed to assess self esteem. Rosenberg (1965) has reported test-retest reliability of .92, and Silber and Tippett (1965) obtained a two-week test-retest reliability coefficient of .85. Construct validity is adequately supported by both convergent and discriminant validity. Silber and Tippett (1965) found moderate to high correlations between the RSE and three other measures of self esteem, indicating that the RSE measures the intended construct. Correlations between the RSE and three self image stability scales were low, providing evidence for discriminant validity.

The Rotter Internal-External Locus of Control Scale (I-E) was designed by Rotter (1966) to differentiate between people who believe rewards and punishments are contingent on their own behavior, capacities, or attributes. Rotter (1966) reported test-retest reliability coefficients ranging from .49 to .83 for various samples and intervening time periods ranging from

one to two months. An internal consistency analysis (Kuder-Richardson) yielded a coefficient of .70 for both males and females.

The Bem Sex Role Inventory (BSRI) is based on the assumption that masculinity and femininity are two independent dimensions of personality rather than bipolar ends of a continuum (Bem, 1974). Bem reported test-retest reliability coefficients for a four-week interval of .90, .90, and .93 for the Masculinity, Femininity, and Androgyny scores. Coefficient alphas were computed for the Masculinity and Femininity scores and provide good evidence of internal consistency; for two samples Bem reported alphas of .86 and .86 for the Masculinity scale and .80 and .82 for the Femininity scale. Bem's subtractive method for deriving the androgyny score has been much criticized (cf., Spence, Helreich, & Stapp, 1975; Strahan, 1975). This study utilizes a scoring method developed by Babl (1979) which requires that the subject meet the conditions of both the subtractive and median split approaches in order to be classified as androgynous. Four categories are derived from this approach: masculine, feminine, androgynous, and undifferentiated.

Three mathematics achievement tests were obtained from the set entitled Cooperative Mathematics Tests developed by the Educational Testing Service (The Cooperative Mathematics Tests Handbook, 1965). The Algebra I Cooperative Mathematics Test was selected for administration to Course Level I. Reliability, reported interms of internal consistency, ranges from .80 to .86 for national samples of 1200 eighth and ninth grade students. The Algebra III Cooperative Mathematics Test was selected for

Course Level II. Internal reliability coefficients for 900 college students range from .80 to .84. The Calculus Cooperative Mathematics Test, Part I, was selected for Course Level III. Internal reliability coefficients range from .84 to .87 for 800 college students.

Procedure

Subjects were tested on the first day of class in their classrooms. The students were given a packet containing a consent form, a background information form (requesting a list of previous mathematics courses, age, and year in college), the RSE, the I-E, and the BSRI. After completing these scales, the mathematics achievement tests applicable to the course were administered. Forms A and B were handed out alternately, so that one-half of each pretest class received Form A and the other half received Form B.

During the final two weeks of the semester, the appropriate math achievement test was administered to each course section. Students were administered the alternate form of the mathematics achievement test given at the pretest, that is, a student who had taken Form A at the pretest was given Form B for the post-test and vice versa. Test materials were administered to at least two sections of each course level as a means of controlling for extraneous effects within sections; sections were comparably sized.

Results and Discussion

No sex differences were noted in math background within course levels (course level is thus an index of math background). Males and females did not differ with respect to age or year incollege within course levels.

In order to test for sex differences in attrition rates the sample was divided into three attendance groups: Group I (n = 53) included students who withdrew from the course; Group II (n = 62) comprised students who withdrew from the experiment but completed the course; and Group III (n = 145) included students who completed the course and participated in the post-test. A three-way chi-square analysis (sex X course level X attendance) indicated that the observed distribution of the sexes was within the deviation expected by chance. Therefore, males and females did not differ with respect to attrition rates from the course or the experiment.

An examination of differences between attendance groups on the other variables was also undertaken. A chi-square analysis indicated no significant differences in sex role identity among the attendance groups. Two two-way (sex X attendance group) analyses of variance (ANOVAs) revealed no significant effects for either self esteem or locus of control. Pretest scores on the math achievement tests were analyzed for males and females separately by means of one-way ANOVAs. The male attendance groups did not differ significantly on math achievement scores, but the females did ($F(2,89) = 3.7$, $p < .05$). A Neuman-Keuls multiple comparison test indicated the females who withdrew from the course evidenced significantly lower achievement scores than either of the other two attendance groups.

Ernest (1976) found that college females receive less encouragement to continue math courses and are usually less confident in their math ability than males. Perhaps negative attitudes toward math, feelings of inadequacy, and/or lack of support may contribute to the female's decision to drop math courses.

A series of t-tests revealed no sex differences in math achievement for any of the course levels. An ANOVA with repeated measures on the math achievement test indicated no sex differences in math learning over the semester. Fennema and Sherman (1977; 1978) have found few sex differences in math performance when number of previous math courses was taken into account. Since most research on sex differences in math ability at the high school and college levels has examined scores from standardized tests without considering sex differences in previous training, significant results may erroneously be attributed to innate ability. Carefully controlled studies which account for previous math experience would eliminate this problem and allow for more precise study of other variables that might account for sex differences in performance. In fact, Sherman (1982, p. 429) claims that "by far the largest source of variance in sex-related differences in mathematics performance can be attributed to differential mathematics training and practice.

The three main sex role identity groups and the three course levels were arranged in a 3 X 3 contingency table (due to inadequate sample size the undifferentiated sex role category was eliminated from the analysis). The chi-square test revealed no differences in sex role identity as a function

of course level. Thus, while some researchers have noted a relationship between masculine identity and math skill (cf. Mills, 1978; Potter, 1975) this study does not find such a relationship.

RSE scores were arranged in a two-way ANOVA with course level and sex as the independent variables. Results revealed a significant interaction between course level and sex on self esteem ($F(2,247) = 3.66$, $p \leq .03$). Female self esteem increased with course level while male self esteem was not consistently related to course level. Starr (1976) found a positive correlation between self esteem and SAT math scores for high school females, but not males, and subsequently suggested that high self esteem facilitated female math performance in a male dominated area. This study indicates that females who enroll in the more difficult math courses are higher in self esteem than those enrolled in the more basic courses. Of course this finding could be due to self selection or a direct relationship between proficiency in math and self esteem.

I-E scores were arranged in a two-way ANOVA with course level and sex as the independent variables. The only finding was a trend suggesting an interaction between course level and sex ($F(2,247 = 2.18$, $p < .12$). Mean I-E scores for females tended to vary with course level, whereas male locus of control did not vary consistently with course level. Although the evidence is not as strong as that for self esteem, a trend toward increasing internal control across course levels and a lack of variability in I-E scores among the females enrolled in Course Level III suggests that locus of control is somewhat related to previous training.

Change scores for pre- and post-test math achievement scores were correlated with I-E scores for males and females separately. There was no relationship between locus of control and math learning over the semester for either males or females. Starr (1976) found a positive relationship between SAT math scores and internal locus of control scores for high school females. She suggested that an internal locus of control facilitated female mathematics performance. The results here do not support this view, though it must be noted that the post-test sample is biased due to attrition, rendering this finding inconclusive.

References

Babl, J. D. (1979). Compensatory male responding as a function of sex role. Journal of Consulting and Clinical Psychology, 47, 252-257.

Bem, S. L. (1974). The measurement of psychological androgyny. Journal of Consulting and Clinical Psychology, 42, 155-162.

The cooperative mathematics tests handbook (1965). Princeton, NJ: Educational Testing Service.

Ernest, J. (1976). Mathematics and sex. American Mathematical Monthly, 83, 595-614.

Fennema, E. (1974). Mathematics learning and the sexes: a review. Journal for Research in Mathematics Education, 5, 126-139. (a)

Fennema, E. (1974). Sex differences in mathematics learning: why??? The Elementary School Journal, 75, 183-190. (b)

Fennema, E., & Sherman, J. (1977). Sex related differences in mathematics achievement, spatial visualization and affective factors. American Educational Research Journal, 14, 51-71.

Fennema, E., & Sherman, J. (1978). Sex related differences in mathematics achievement and related factors: a further study. Journal for Research in Mathematics Education, 9, 189-203.

Hinders, D. (1977). An explanation of sex differences in student effort in mathematics: the impact of differences in social influences, articulation to future work and related grades to ability (Doctoral dissertation, Stanford University, 1977). Dissertation Abstracts International, 37, 7591A-7592A.

Mednick, M.T.S., & Weissman, H. J. (1975). The psychology of women, selected topics. Annual Review of Psychology, 26, 1-18.

Mills, C. J. (1978). Sex role related personality correlates of intellectual ability in adolescents (Doctoral dissertation, Johns Hopkins University, 1978). Dissertation Abstracts International, 39, 1936B.

Norman, R. D. (1977). Sex differences in attitudes toward arithmetic mathematics from early elementary school to college levels. Journal of Psychology, 97, 247-256.

Potter, N. (1975). Mathematical and verbal ability patterns in women (Doctoral dissertation, University of Missouri-Columbia, 1974). Dissertation Abstracts International, 36, 425B.

Rosenberg, M. (1965). Society and the adolescent self image. Princeton, NJ: Princeton University Press.

Rotter, J. B. (1966). Generalized expectancies for internal versus external control of reinforcement. Psychological Monographs: General and Applied, 80, 1-28.

Sherman, J. (1978). Social values, femininity, and development of female competence. Journal of Social Issues, 32, 181-195.

Sherman, J. (1982). Mathematics the critical filter: A look at some residues. Psychology of Women Quarterly, 6, 428-444.

Silber, E., & Tippett, J. S. (1965). Self esteem: clinical assessment and measurement validation. Psychological Reports, 16, 1017-1071.

Spence, J. T., Helmreich, R., & Stapp, J. (1975). Ratings of self and peers on sex role attributes and their relationship to self esteem and conceptions of masculinity and femininity. Journal of Personality and Social Psychology, 32, 29-39.

Starr, B. S. (1976). Sex differences among personality correlates of mathematical ability in high school seniors. (Doctoral dissertation, Rutgers University, 1975). Dissertation Abstracts International, 36, 3568B.

Strahan, R. F. (1975). Remarks on Bem's measurement of psychological androgyny: Alternative methods and supplementary analysis. Journal of Consulting and Clinical Psychology, 43, 568, 571.